



Boeing Technology

Maintenance Program and New Materials on Boeing Commercial Aircraft

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Agenda

- **Summary of Maintenance Program**
- **Drivers for implementing new materials**
- **Replacement of Alodine 1000**
- **B787 Finishes**

BCA Maintenance Program

- **Well defined program for all models**
- **Old system used letters**
 - “A” check -- intended to disclose the general condition of the aircraft
 - “C” check -- greater depth of inspection throughout the airplane to ensure continued airworthiness
 - “D” check – Major systems/operational/functional checks, aircraft modifications, cabin refurbishment, painting, structural inspections, etc.
- **Operations based system has layered inspections**
 - based on flight hours or calendar
 - Varies by aircraft and operator
- **System maintenance**
 - Lubrication, operational/functional,
- **Zonal Inspection**
 - Combines general inspections and CPCP
- **Structural maintenance**
 - Detailed and special detailed inspections
 - Must maintain a “damage tolerance rating”
- **Military usage of airframes will not match commercial service**
 - Maintenance intervals and practices will need to be adjusted

Fleet Average Intervals (hours)			
model	"A"	"C"	"D"
737	~400	~5000	~20000
767	~200	~5000	~28000
747	~600	~5000	~48000

“Operations” Maintenance Program

B747 Structural Program

STRUCTURAL MAINTENANCE PROGRAM

MPD NUMBER	AMM REFERENCE	P G M	Z O N E	ACCESS	INTERVAL		APPLICABILITY		MAN- HOURS	TASK DESCRIPTION
					THRESHOLD	REPEAT	APL	ENG		
XX-XXX-XX										<p>AIRPLANE MAINTENANCE MANUAL PROCEDURE (CHAPTER, SECTION, SUBJECT) WHICH SUPPORTS THE MPD REQUIREMENT.</p> <p>MPD Sequence number</p> <p>MPD Sequence number</p> <p>First two digits = ATA Chapter</p> <p>Maintenance Program Type (C = Corrosion, F = Fatigue, S = Structures)</p>
53-501-00		S								<p>INTERNAL-GENERAL VISUAL: AREA FORWARD OF NOSE LANDING GEAR WHEEL WELL. LOWER LOBE SKIN PANELS-FORWARD OF BODY STATION 246. LONGITUDINAL SKIN LAP SPLICES. FORWARD ACCESS HATCH-CUTOUT STRUCTURES including skin within 20 inch periphery of cutout. FORWARD ACCESS HATCH-CUTOUT STOP FITTINGS AND BACKUP STRUCTURE. FORWARD PRESSURE BULKHEAD BODY STATION 132.5. NOSE GEAR WHEEL WELL-FORWARD BULKHEAD. FLOOR BEAMS.</p> <p>INSPECTION NOTE: 126.5 to 180.5 "ONLY"</p> <p>INTERVAL NOTE: Whichever comes first. Repeat interval satisfied by corrosion Items 3-653 and 53-65.</p> <p>ACCESS NOTE: Insulation blanket removal/displacement required.</p>

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Drivers for change in aerospace finishing technology...

Safety / Environment



Performance



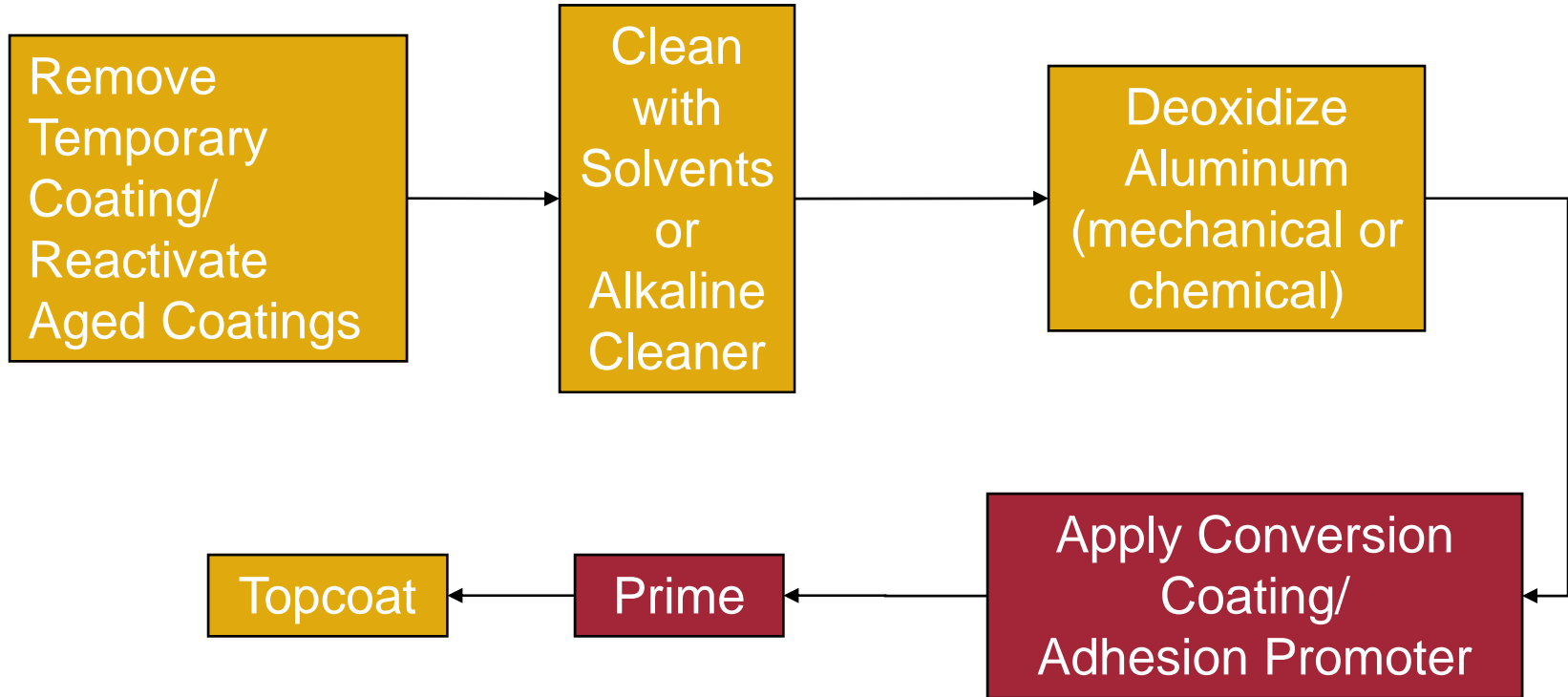
Process



When does “change” occur?

- **Technologies introduced with new models / major redesign**
 - **Need to meet engineering performance requirements and have production volume capability**
 - **New Substrates**
 - High strength steels
 - Light metals
 - Composite structure
 - **Chromium plating replacements**
 - Most models now have HVOF
 - **Chromate conversion coating replacements**
 - Need to maintain or improve performance
 - **Chromate corrosion inhibitor replacements**
 - Nonchromate systems not yet as capable
 - **Cadmium replacements**
 - Alternatives moving toward implementation
 - **Repair/Maintenance of new materials is important**
- **Technologies introduced for significant performance or process improvement**
 - **Replacement of Alodine 1000 for aircraft painting operations**

Exterior Finishing Process

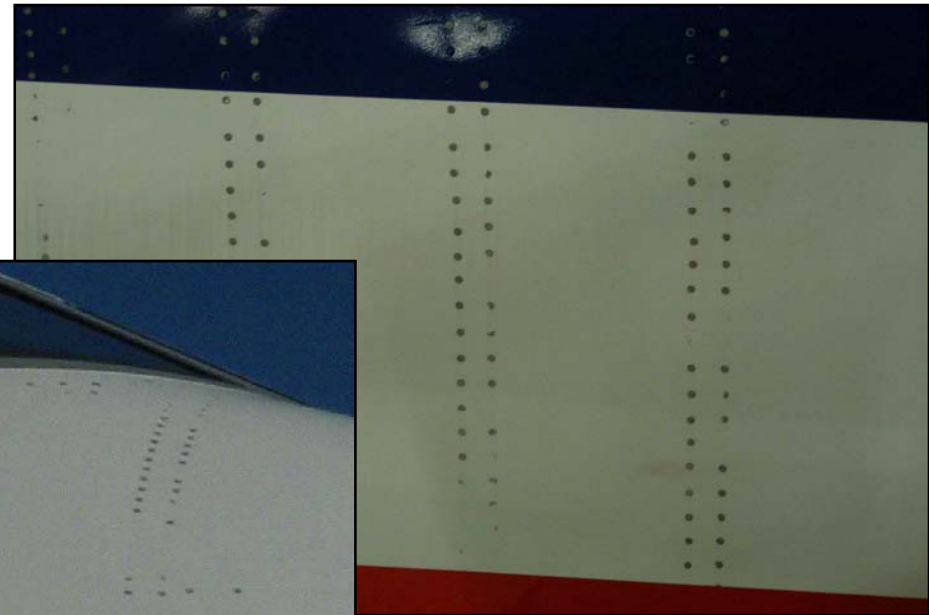


- Each process and material in the exterior coating system is critical to ensure overall durability
- Changes require careful consideration....and a lot of testing and verification

Performance Driver - Rivet Rash Reduction

Paint delaminates from rivets but not fuselage skins

- Affects all models and decorative paint systems
- Conventional conversion coating identified as contributing factor



In-Service Data – Production Trial Airplane

Comparison of
two 777-200LRs
with different
pretreatments



Rivet Rash on First
777-200LR
(**conventional
conversion coating**)
<400 Flight Hours



No Rivet Rash on 2nd
777-200LR
(**AC131-CB / Boegel EPII**)
<400 Flight Hours

Depainting – Production Trial Airplane



4-12 mils of paint



1st Strip Coat
6.5 hours dwell



1st Strip Coat
8 hours dwell + squeegee



2nd Strip Coat
6 hours dwell + squeegee



4th Strip Coat
8 hours dwell + squeegee



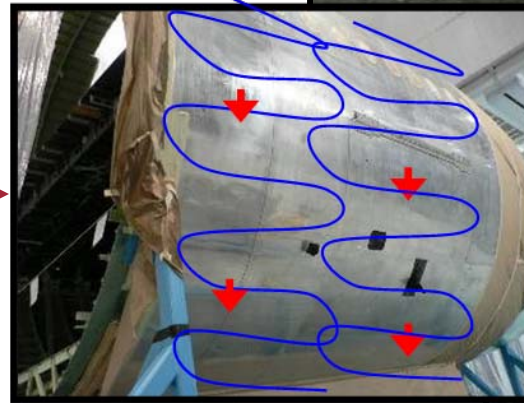
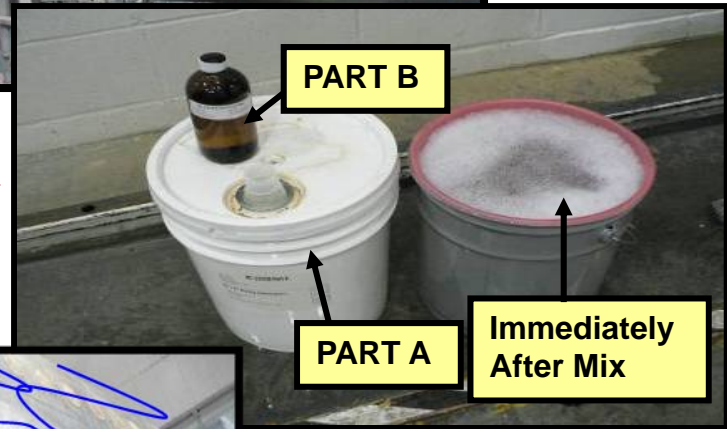
Abrade and rinse

Process Optimization

- Solvent clean
- Deoxidize (chemical or mechanical)
- Water break free check
- Mask for Prime

1. Mix 2-part kit & shake 5 Min
2. 30 minute induction time
3. 24 hour pot life
4. Apply with air-assisted airless paint gun with small fluid tip
5. Spray top down
6. Apply minimum amount to wet surface
7. Allow 10 minutes drip
8. Wipe off excess, if necessary
9. Tape after dry, 1 hour min

- Complete mask for prime



Implementation

Everett Decorative Paint Operations implemented AC131-CB/Boegel EPII for 777s in March 2007



Elimination of ~ 400 gallons of chromated pretreatment and wastewater material per 777

Impact to Boeing

	Conventional	AC-131-CB / Boegel EP-II
Health & Safety	Contains Hexavalent chromium pH = 2.1	No Hexavalent chromium pH= 6
Environmental Impact	Volume of chromated coating: ~100 gallons/twin aisle ~25 gallons/single aisle Rinse water that requires remediation: ~300 gallons/twin aisle ~75 gallons/single aisle	Volume of chromated coating: None Rinse water that requires remediation: None
Durability	Rivet Rash is Problematic	Reduces Rivet Rash

Advanced Materials Usage

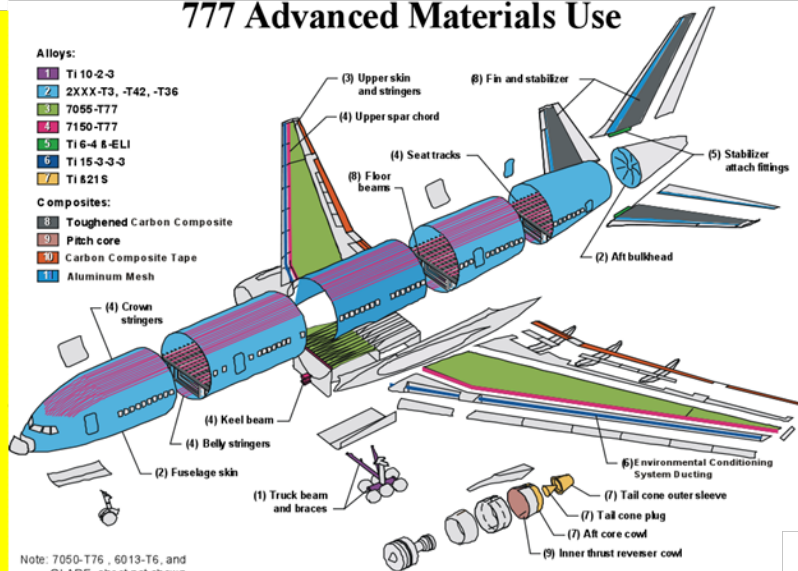
777 Advanced Materials Use

Alloys:

- 1 Ti 10-2-3
- 2 2XXX-T3, -T42, -T36
- 3 7055-T77
- 4 7150-T77
- 5 Ti 6-4 & ELI
- 6 Ti 15-3-3-3
- 7 Ti 821S

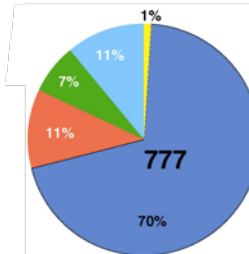
Composites:

- 8 Toughened Carbon Composite
- 9 Pitch core
- 10 Carbon Composite Tape
- 11 Aluminum Mesh



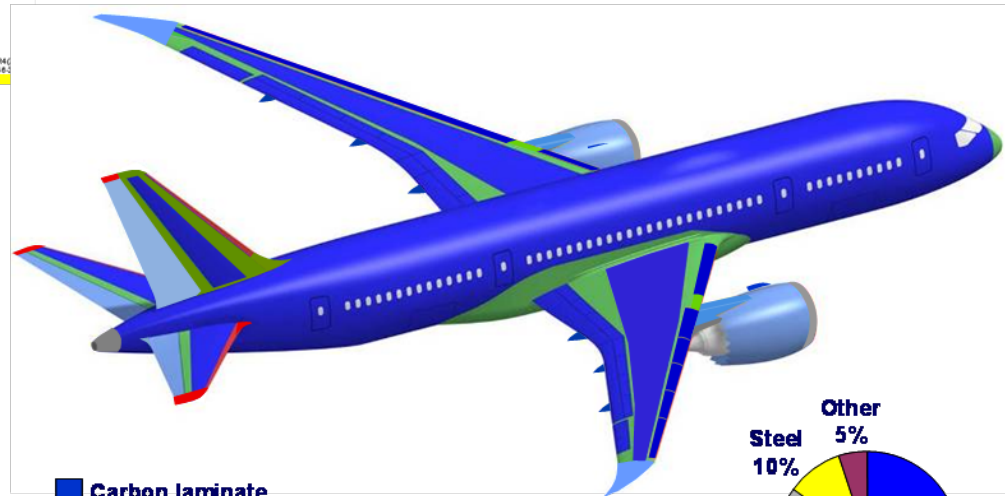
Note: 7050-T76, 6013-T6, and GLARE sheet not shown

32 2772-18 R4C
M-3

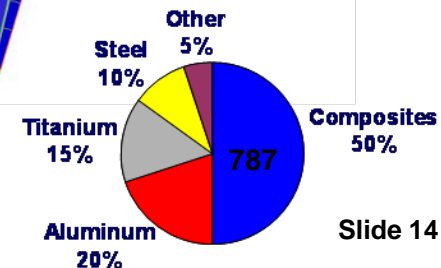


- Steel
- Titanium
- Composite
- Misc.
- Aluminum

787 Composite Primary Structure




- Carbon laminate
- Carbon sandwich
- Other composites
- Aluminum
- Titanium



Selectively Strip-able Topcoats

BMS10-13 paint stripper is applied to the paint system



Decorative colors (BMS10-125)
Initial topcoat (BMS10-126)
Intermediate coating (BMS10-120)
Exterior primer (BMS10-118)
Co-cured surfacing film (BMS8-341)
Graphite Skin (BMS8-276)

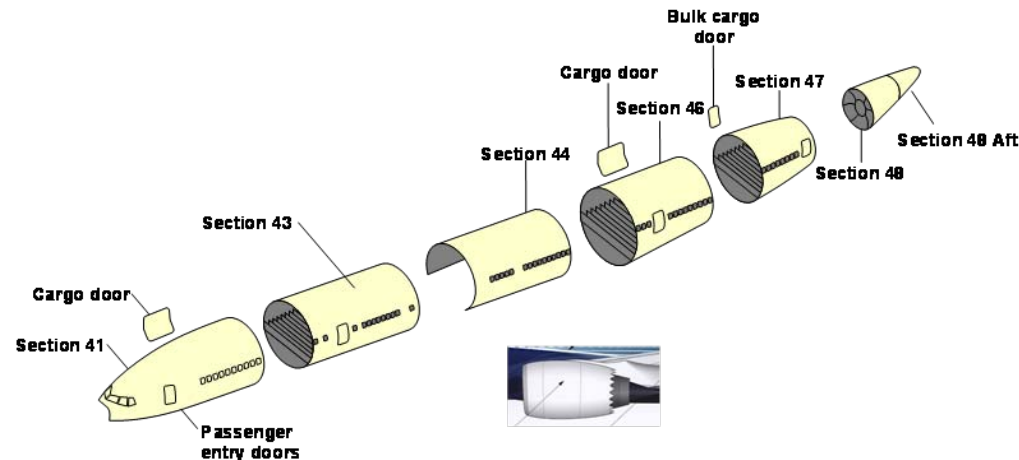


Over time, the paint stripper swells and delaminates the BMS10-120 intermediate coat from the BMS10-118 primer, removing the topcoat and most of the intermediate coat

Exterior primer (BMS10-118)
Co-cured surfacing film (BMS8-341)
Graphite Skin (BMS8-276)



Substrates Approved for Chemical Stripping



During repaint, a thin layer of primer, the intermediate coat and the decorative paint is applied

Decorative colors (BMS10-125)
Intermediate coating (BMS10-120)
Exterior primer (BMS10-118)
Co-cured surfacing film (BMS8-341)
Graphite Skin (BMS8-276)

Summary – Opportunities and Challenges

- **Maintenance program is based on operations experience**
 - **Manual has sections for all models and operators**
- **New materials must meet performance requirements**
- **Must meet OEM production and sustainment cost objectives**
- **Need to facilitate new technologies to production ready status**
- **Overall objective is to produce a safe vehicle that is economical to acquire and operate**

Questions?

